

# Assessment of Land Suitability Through Conventional Method: A Micro Level Analysis in Koch Bihar District, West Bengal

<sup>1</sup>Rajib Mitra and <sup>2</sup>Prasanya Sarkar

<sup>1</sup>Research Scholar, Department of Geography & Applied Geography, University of North Bengal, West Bengal

<sup>2</sup>Guest Teacher, Cooch Behar College, West Bengal

---

## ARTICLE DETAILS

### Article History

Published Online: 07 September 2018

### Keywords

Soil texture, Land Suitability, limitation, Koch Bihar, productivity, FAO.

---

## ABSTRACT

It is necessary to understand the meaning of land, in its proper perspective as well as in the wider sense. Land is a basic natural resource. Land of any region is essential to be evaluated in respect of productivity. The productivity of land determined by the quality of soil properties. The characteristics of the soil are mainly determined by the topography, climate, parent material, vegetation of that region. Soil is a basic factor for socio-economic development of any region. It also effects on the livelihood pattern of that region. In the study area the researchers have found that most of the people in this area depends on soil for cultivating their lands. Soil survey of any region helps to identify different land use problems. In the entire research, the authors have attempted to determine the suitability of different land segments of the study area. Land suitability evaluation has been prepared followed by FAO methods (1976, 1977, 1983, 1985, and 2007). The field properties of taxonomic classes have been noted and classification has been carried out following the FAO system, the different negative or limitation factor, i.e. (e-erosion, w-wetness, s-soil, c-climatic) are indicate from geomorphological properties, soil characteristics, local condition and with the help of Land Judging Form (1974). In order to this detail field survey has been done to find out the relationship between different variables of the study area. The results show that study area has been classified from the suitability view point into two suitability classes, namely, moderately suitable (S2) and marginally suitable (S3) and further divided into five sub-classes namely, S2s, S2se, S2w, S2e, S3e. Basically, it is a micro-level study to prepare a scale of suitability classes for proper utilisation of cultivable lands and to identify the suitability degrees and display the spatial representation of soil suitable for agriculture.

---

## 1. Introduction

Land of any region is essential to be evaluated in respect of productivity. The analysis of land performance is called as land evaluation (FAO, 1976). Land is a basic natural resource. Ecologically, land is a renewable resource. The productivity of land can be determined by the quality of soil properties. The characteristics of the soil are mainly determined by the topography, climate, parent material, vegetation of that region. The developing countries facing the challenges to producing food, fuel and fodder in terms of quantities for sustainable life. It is necessary to increase the productivity of land and enhance the quality of the ecosystem by adopting conservation measures. Crops can be cultivated in the same land year after year if the quality of land is maintained in a proper rational manner. Land use of any area may also play a vital role in assessing land. Land evaluation is the process of collecting and interpreting basic parameters of soil, climate, vegetation and some other aspect of land in respect of socio-economic criteria. Improvement of the use of land is essential to any significant increase in food supply in developing countries of the world. After the primary classification of land of any region, it is important focusing on the developmental planning and management of land. Land suitability is the ability of a portion of land to tolerate the growth of crops in a sustainable way (Abdel Rahman, et al, 2016). The objective of the present work is to collect detailed information about the study area and to classify areas under consideration based on land suitability

classes, keeping these aspects in mind a case study has been made in Dinhat Block-I of Koch Bihar (spelling as per District Census Handbook, 2011) District in West Bengal. Land suitability classes have been represented following the FAO (Food and Agriculture Organization of the United Nations) methods (FAO, 1976, 1977, 1983, 1985, 2007). The different limitation factor, i.e. (e-erosion, w-wetness, s-soil, c-climatic) are identified from geomorphological properties, pedological characteristics, some local attributes, field study and with the help of Land Judging Form (Burnham, et al, 1974). The evaluation of land based on FAO guideline has been demonstrated earlier by several researchers and scientists (Sehgal, et al, 1991; Merolla, et al, 1994; Bhaskar, et al, 1996; Beek, et al, 1997; Satyavathi, et al, 2004; Bandyopadhyay, et al, 2009; Sathish, et al, 2010; Rahman, et al, 2016).

## 2. Study Area:

The Koch Bihar District is situated almost at the foothills of the Eastern Himalaya. The Area of the District is 3387 Sq. km, which contributes 3.82% of the land mass of the state of West Bengal. The District is a flat land with a slight south-eastern slope. Most of the rivers flow in a slanting course from north-west to south-east direction entire the District. The District is fall under the Jalpaiguri Division of the state of West Bengal. It is located in the north-eastern part of the state and bounded by the District of Jalpaiguri and Alipurduar in the north, Assam in

the east and by Bangladesh in the west as well as in the south. The District forms part of the Himalayan terai of West Bengal. The highlands of the District is Sitalkuchi area and most of the lowlands lie in Dinhata area. The soil is alluvial of very recent formation. It is mostly sandy and loose. The rivers flow from north-west to south-east. Six river systems cut through the District flowing in a south-easterly direction. From the west to east these are: the Tista, Jaldhaka, Torsa, Kaljani, Raidak and Gadadhar system. The whole study is conducted in the Dinhata-I Block of Dinhata Subdivision in Koch Bihar District.

Koch Bihar District comprising 12 Community Development Block, among them Dinhata Block-I is significant for its own physical, socio-economic set-up. Dinhata town mainly characterised by agricultural based commercial functions. The Block lies between the extension of 26°00' to 26°14'26" North latitudes and 89°19'09" to 89°30'33" Eastern longitudes. The Block is bounded on the North by Koch Bihar-I Block, in the South by the Indo-Bangladesh border, in the east

by Dinhata-II Block and in the west by Sitai Block. The Block is formed by 16 Gram Panchayats. The total population of the Dinhata-I Block is 322393 persons (Census 2011). Among them, 165946 are males and 156447 are females. Total geographical area covered 248.54 Sq. km. The rural area consists 247.08 Sq. km and urban area consists 1.46 Sq. km. Total number of villages are 130 whereas the total number of inhabited villages is 128, total number of census town is 1 and total number of statutory town is 1. The density of population is 1134 persons/Sq. km, while District represents 832. So the area falls under high density of population region. The literacy rate is 73.05% (literacy rate of Koch Bihar District is 74.78%). Among the total geographical area, the total area available for cultivation is 22939.33 Hectare and irrigated area is 55.22%. The total number of cultivators of the Block is 34673, agricultural labourers is 44440, household industries workers is 4145 and other workers is 30475 (Statistical Handbook, Koch Bihar, 2011).

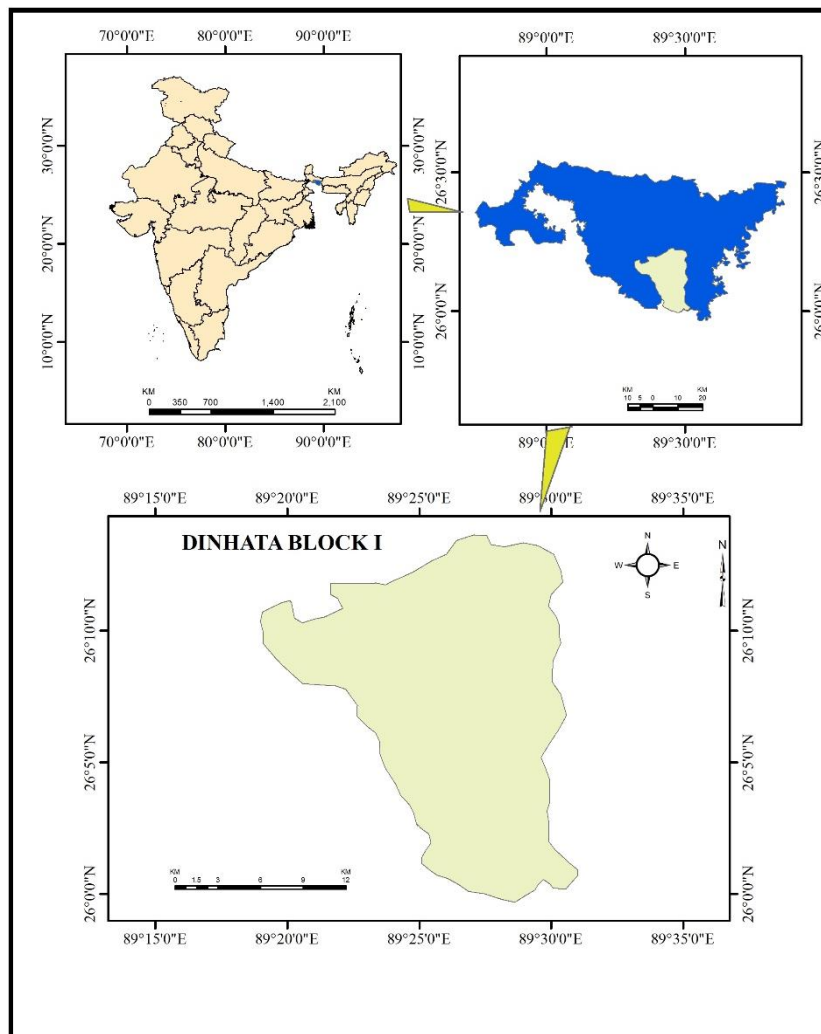


Fig. 1 Location Map of the Study Area

The Block has 89784 main workers, 23949 marginal workers and 172536 non-workers. As the soil of the Block is suitable for production of agriculture, large number of people depend upon the agricultural land for their livelihoods. The increasing number of the population leads to increase the total

cultivable area. The soil is very suitable for cultivation of different crops. The principal crops are paddy, jute, tobacco, maize, potato, masur, maskalai, khesari, mustard, etc. But as there are few limitations on the uses of land, it is very necessary to use fertilizer and apply irrigation.

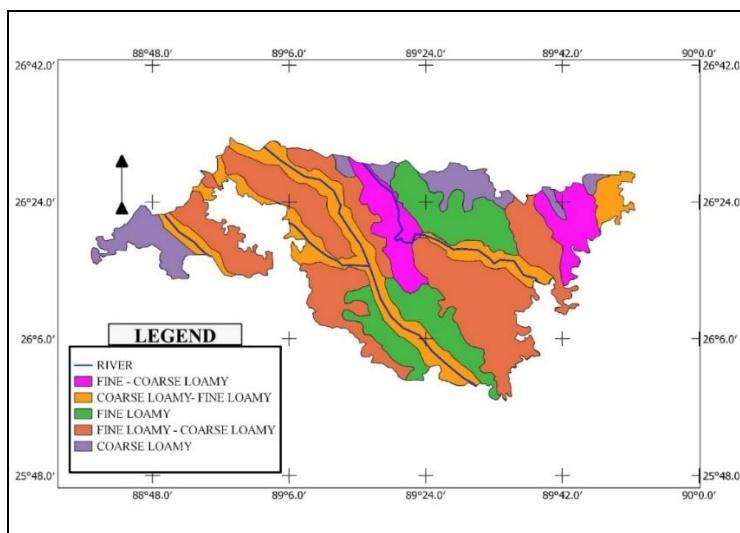


Fig. 2 Soil Map of the District Based on Agriculture Contingency Plan

The nature of irrigation system is river lift irrigation, deep tube well, shallow tube well, open dug well etc. Ground water of this region is good and potable for both agricultural and

domestic purposes. Around 50% of the total tobacco cultivation of the state is produced in Dinhatia Subdivision which promotes the livelihood of a huge portion of the population in this region.

Table 1: Month-Wise Mean-Maximum & Mean-Minimum Temperature and Rainfall of Koch Bihar District, 2012

Month	Temperature (in °C)		Rainfall (in mm)
	Mean Max.	Mean Min.	
January	23	9	3
February	26	11	11
March	30	15	3
April	31	20	173
May	33	23	242
June	31	24	947
July	32	26	779
August	33	26	337
September	32	25	614
October	31	20	245
November	29	13	-
December	24	11	-

Source: Meteorological Department, Government of India and Agricultural Meteorologist, Directorate of Agriculture, Government of West Bengal

3. Materials and Methods:

To analysis the physical characteristics (geology, climatic, soil, drainage, etc.) and socio-economic status (demography, economy, occupation, etc.) of the study area, data collected from different published sources. The data sources are USGS maps in 1:250000 scale, geological maps from Geological Survey of India, Google Earth images (free source) satellite data, DEM (ASTER data of 30 m spatial resolution), District Census Handbook, Village and Town Directory of Koch Bihar District (2011), District Gazetteer, Agricultural Contingency Plan of Koch Bihar (2001, 2011), District Statistical Handbook. Rainfall data have been collected from India Meteorological Department. The necessary data also collected from National Bureau of Soil Survey and Land Use Planning, Regional

Centre, Kolkata (2008), Agricultural office of Dinhatia Block-I and Central Tobacco Research Institution of Dinhatia. For the study of elevation of the region ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) data with 30 m resolution has been used. After processing in GIS software, a digital elevation map has been prepared. Satellite image (Landsat 8 OLI) has been downloaded from the USGS Earth Explorer site. Drainage density and stream frequency are calculated by following the R. E. Horton's (1932, 1945) method, i.e. Drainage Density (Dd) = L/A; where, L is the total length of the stream and A is the area drained, Stream Frequency (Fs) = N/A; where, N is the total number of stream and A is the area drained.

Table 2: Satellite Imagery Attributes

Sensor	Path	Row	No. of Band
OLI-TIRS	138	042	11

Land suitability evaluation has been prepared followed by FAO methods (FAO, 1976, 1977, 1983, 1985, 2007). The field properties of taxonomic classes have been noted and classification has been carried out following the FAO system, the different negative or limitation factor, i.e. (e-erosion, w-wetness, s-soil, c-climatic) are indicate from geomorphological properties, soil characteristics, some local condition and with the help of Land Judging Form. Besides mapping techniques have been done with the methods obtained from literature. Information has been analysed to study the pedogenic characteristic, soil fertility (Das, et al, 2015) and nature of the land in the study area. In order to this detail field survey has

been done to find out the relationship between physiography, drainage and the existing land use pattern of the study area. To make land suitability classes the author used the Land Judging Form (Burnham, et al, 1974). Suitability classes are described on the basis of a Conversion Table. Here each kind of limitation is the worst condition that can be accepted within the class. Different site-wise rating of parameters based on Land Judging Form have been done (Table 3). Several parameters like, climate (C), gradient (G), erosion (E), soil (S), wetness (W), etc. the authors have been used for generation of the suitability map of Dinhata Block-I.

**Table 3: Site-Wise Rating of Different Parameters in the Study Area**

Site	Climate (C)				Gradient (G)	Erosion (E)			Soil (S)					Wetness (W)					Suitability Class	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		S
Bara Soulhari	1	1	1	2	1	3	2	1	1	2	3	1	1	1	1	1	1	1	1	S2e
Gitaldaha	1	1	1	1	1	4	1	1	1	2	4	1	2	1	1	1	1	1	1	S3e
Bara Atiabari	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	S2e
Bhangni	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	S2s
Bhetaguri	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	S2w
Matalhat	1	1	1	1	1	3	1	1	1	1	2	1	1	1	1	1	1	1	1	S3e
Petla	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	S2se
Gosanimar i	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	S2s

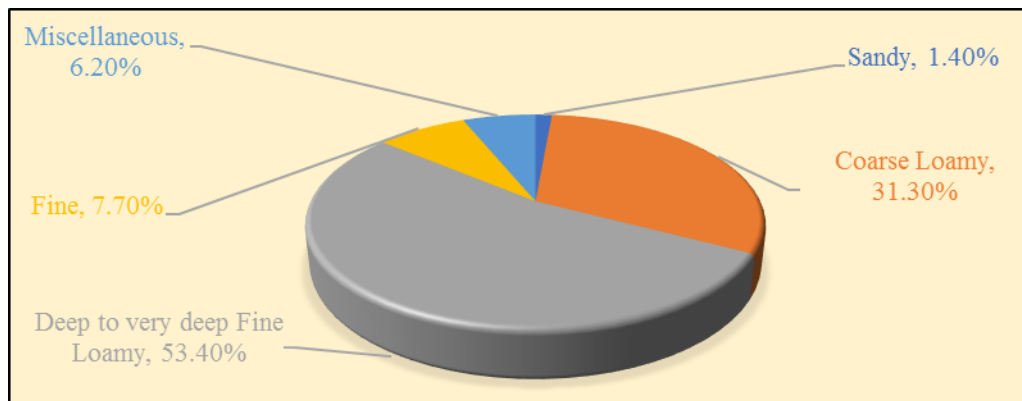
**Source:** Computed by the Authors Based on Land Judging Form (Burnham, et al, 1974)

#### 4. Results and Discussion:

Soil characteristics are mainly determined by the topography, climate, parent material, vegetation of the region. Soil of any region is a determinant factor for socio-economic development of any region. It also effects on the livelihood pattern of that region. In the study area the researchers have found that most of the people depends on soil for cultivating their lands. Soil survey of any region helps to identify different land-use problems. Soil fertility determines the nutrient availability for plant growth. At least plant require 17 elements (both macro and micro elements) for their growth. Nitrogen (N), Phosphorous (P) and Potassium (K) are the three primary macro-nutrients for providing basic facilities for the growth of plants. They are used in a great quantity for the fertility of the soil. The boron, copper, chlorine, iron, manganese, molybdenum, zinc, etc. are the micronutrients essential for plant growth.

Topographically, the whole region is characterised by flat surface with minor undulation. As slight southern slope present in the District, for this numerous 'tal' or lowland area found in the Block. Geologically, the total Block is covered by alluvial formation of recent period. Quaternary sediments covered the entire Block. Three morphostratigraphic units found in this region viz., Jalpaiguri formation, Shaugauon formation and present day flood plain deposit. The rivers originating in the Himalayas to the north and during monsoon inundate the low lying areas. There are no hilly tracts within the Block and the maximum part of the Block is cultivated land. All the rivers

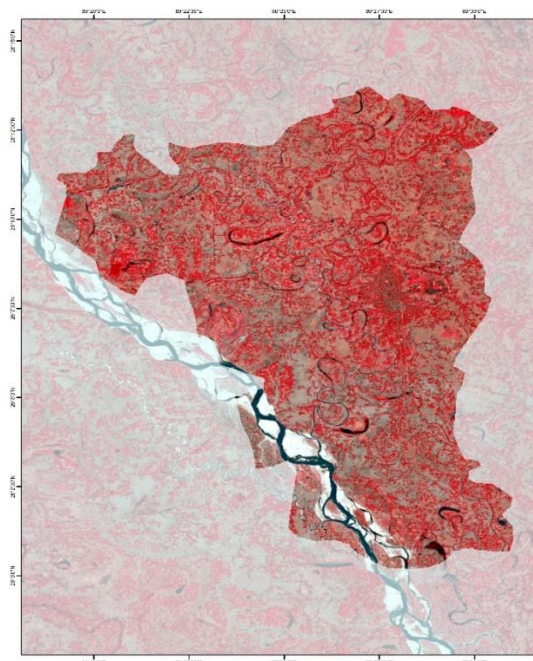
follow the general slope of the area which is from north to south. Most of the low lying lands lie in Dinhata area. The average elevation of Dinhata town is 36 metres. Five distinct seasons (summer, monsoons, autumn, winter and spring) can be seen in the region, of which summer, monsoons and winter are more dominant. The whole region is characterised by highly humid, but from February to March relative humidity is around 60%. The average monthly temperature was highest during August (29.5 °C) and lowest in January (17.5 °C) in the year 2012. Average annual rainfall of the region is about 2900 mm. The cold weather occurred during December to February is obviously due to north-east monsoon whereas rainy season lasts from June to September. In this region winter starts from December and carries on till February and this period is used for Rabi crop cultivation. The main rivers of the Block are Jaldhaka, Singimari and Dharla rivers. There are some small rivers in the Block, namely, Bura Dharla, Gidari etc. Besides the rivers there are some bill like, Bhaturch Bill on the north-eastern corner of the Block. Most of the rivers are perennial in nature. The rivers are characterised by sinuous, ox-bow lakes, mid-channel bar or shoal, wider valley, abandoned and anabranching channels, etc. The natural vegetation cover found very less in its area in the Block. The amount of vegetation is high in the western part. It is located along the Singimari River. Although some other parts of the Block is covered by less, irregular and isolated jungle.



**Fig. 3** Distribution of Soil in the Region

The major environmental hazard of the area is occurrences of flood hazard during monsoon season due to heavy rainfall in the upper catchment area of the rivers. Parallely bank erosion and river channel migration also play a noticeable role in this region. The amount of sand, silt and clay of the region reveals a good texture, which is suitable for production of different types of crops. Soil characteristics of any region mainly reveal the physical and chemical properties of the particular soil. The soil of the region is formed by alluvial deposition of different river system. Stream frequency is expressed as the total number of stream segments of all orders per unit area. The concept of stream frequency has been postulated by R. E. Horton in 1932 (Doomkamp, et al, 1971). The stream frequency of the region varies from 2 to >4 number

of streams per Sq. km. The present study indicates that the maximum area of the Block falls under moderately low to moderate drainage frequency zone. The drainage density indicates the closeness of spacing of channels, thus providing a quantitative measure of the average length of stream channel for the region. It has been observed from drainage density measurement that a low drainage density is more likely to occur in a region of highly permeable sub-soil material under dense vegetative cover and where relief is low and on the other hand high drainage density is the resultant of weak or impermeable subsurface material, sparse vegetation and mountainous relief. In the study area, it has ranged between 0.5 to > 1.5 Km/Sq. km and most of the area falling under low drainage density zone.



**Fig. 4** Drainage Map of the Study area

Soil texture is defined as the amount of sand, silt and clay present in a soil of any area. It is often possible to identify the soil texture by its feel, for example sands feel gristly to touch. Texture results principally from mineral composition of the parent materials. It is observed that the study area has coarse loamy, fine loamy and fine textural class. Most of the part of the Block is covered by fine loamy soil mainly in southern, south-western and western parts. Fine-loamy to coarse-loamy soil is found in the eastern portion whereas coarse loamy-fine loamy

soil covered along the riparian areas. The coarse loamy textural group mainly covered in Matalhat, Bara Atiabari and Bhetaguri regions. The amount of organic matter plays an important role as the 'storehouse' of plant nutrients. The organic carbon of the soil has its origin in the decay of dead plants and animal substances incorporated in the various ways in the soil. The percentage of organic carbon ranges between <0.50 to >0.75 in the Block. Most of the parts of the study area contained low organic carbon status (<0.50%). Lowest organic

carbon content area has been found in a large portion in the middle parts, i.e. Putimari, Petla, Gitaldaha, Bara Atiabari areas. In the northern and south-western parts of the area consist Medium organic carbon status (0.50-0.75%). This is mainly covered in the Matalhat, Bhetaguri and Bara Soulhari areas. The highest (>0.75%) amount of organic carbon content found in the north-western parts. It is covered in the Gosanimari area. One of the most important characteristics is soil reaction.  $P^H$  is a scale through which soil reaction may be estimated. Soil reactions represent the degree of acidic or basic caused by the relative concentration of  $H^+$  or  $OH^-$  ions present in it. There are three types of soil reaction, i.e. acidic, alkaline and neutral. Soil acidity is very common in the region due to precipitation is high enough to leach an appreciable amount of exchangeable bases from the surface layer of soil so that the exchange complex is dominated by Hydrogen ions. In the study area the distribution of  $P^H$  value founds a normal tendency with a slight negative deviation. The nature of the soil  $P^H$  varies from strongly acidic (<4.5) to slightly alkaline (7.5-

8.5). It has been identified that most of the soil of the study area is acidic ranges from 4.5 to 5.5. It is observed in the Gosanimari, Matalhat, Petla, Bhetaguri, Bara Atiabari and Bara Soulhari regions. Neutral and slightly alkaline soil (6.5-8.5) found in the Gitaldaha area in a discontinuous pattern. The NPK status of a soil plays a significant role. Nitrogen content in the surface soil of the study area has been described in the figure 5 (f). It has been shown in the map that maximum part of the Block covered by low amount (<280Kg/ha) of nitrogen. It has been identified from the analysis that the percentage of nitrogen is high (>450 Kg/ha) in some isolated areas of the Block. Bara Soulhari, some part of Gosanimari and Bhangni areas are comprises highest amount of nitrogen. The nitrogen content is low (<280 Kg/ha) mainly in the middle portion of the study area which further extends in the north, north-west and south-eastern parts. Lowest amount of nitrogen consists in Putimari, Gitaldaha, Bhangni and Bhetaguri areas. The nitrogen content status is medium (28-450 Kg/ha) in the of Matalhat, Bara Soulhari and Gosanimari areas.

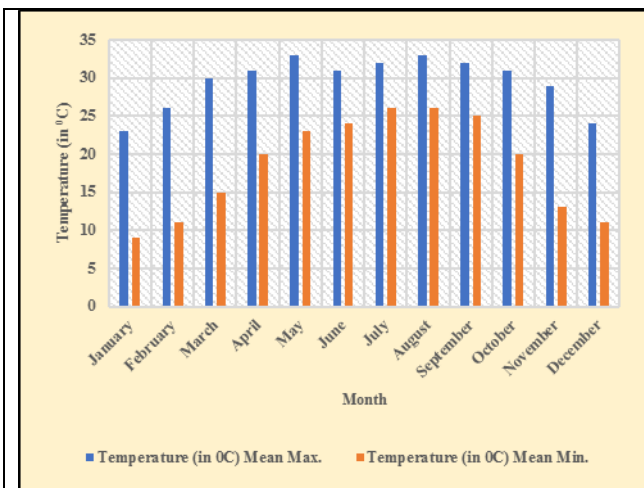


Fig. 5 (a)

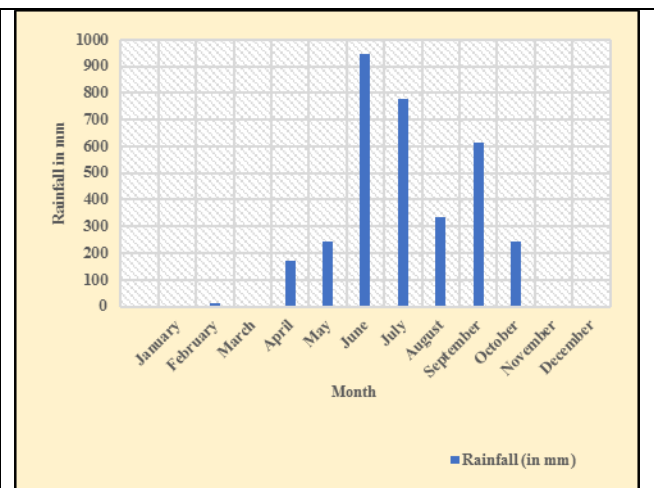


Fig. 5 (b)

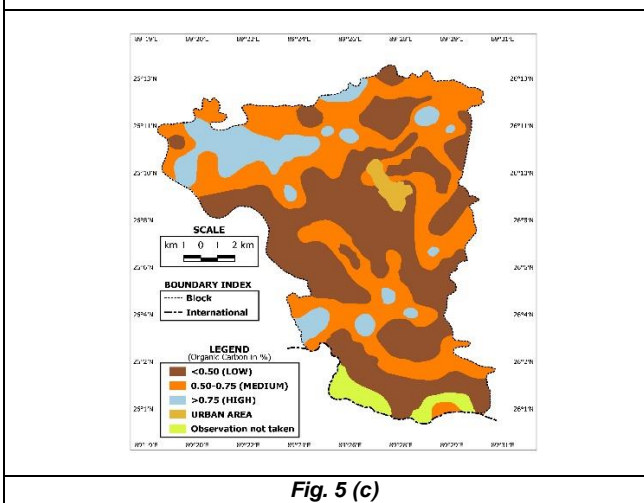


Fig. 5 (c)

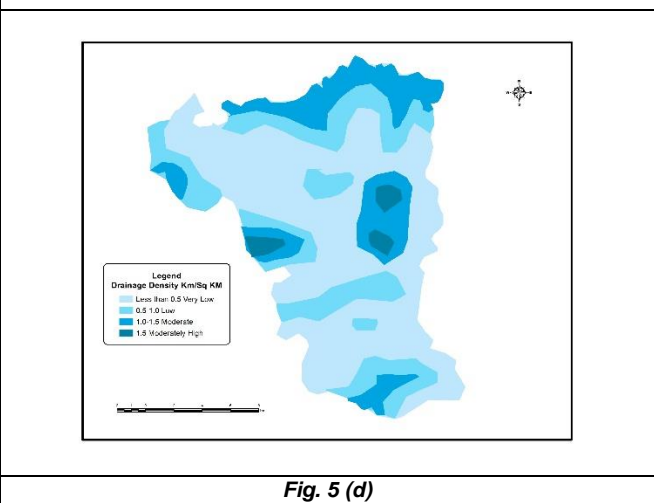


Fig. 5 (d)

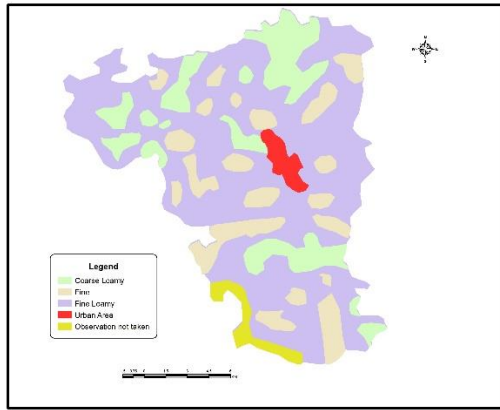


Fig. 5 (e)

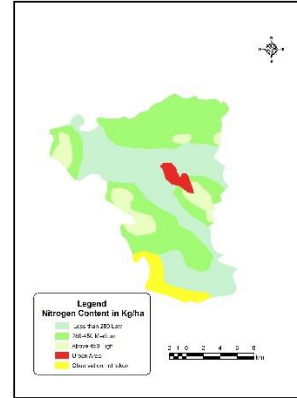


Fig. 5 (f)

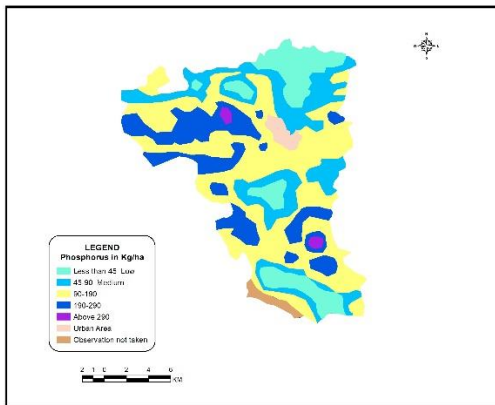


Fig. 5 (g)

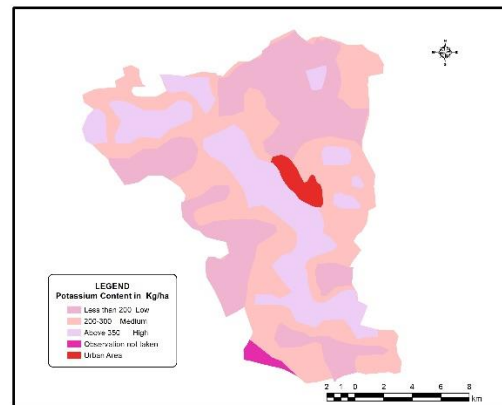


Fig. 5 (h)

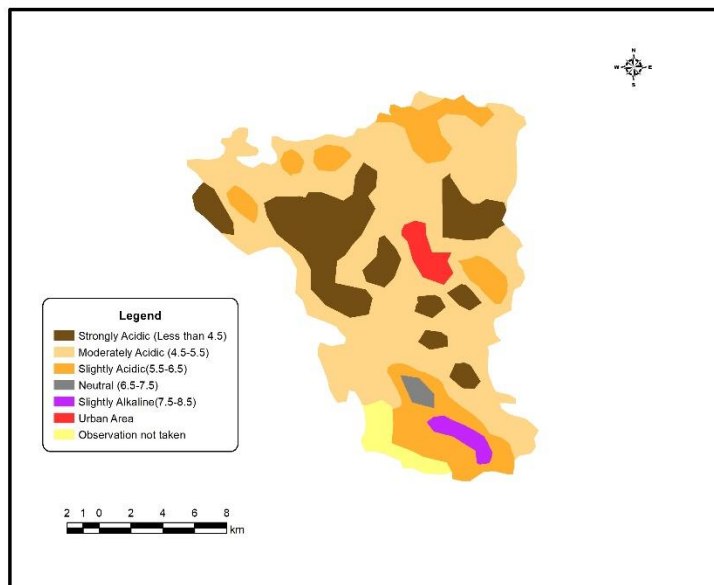


Fig. 5 (i)

Fig. 5 (a) Temperature ( $^{\circ}$ C), (b) Rainfall (mm), (c) Carbon Content (%), (d) Drainage Density (Km/Sq. km), (e) surface texture (f) Nitrogen Content (Kg/ha) (g) Phosphorous Content (Kg/ha) (h) Potassium Content (Kg/ha) (i) Soil Reaction of the Study Area

High amount (90-190 Kg/ha) of phosphorous broadly distributed over the region. It is mainly covered in the central, eastern, southern, western and north-western part of the study

area. It lies in the Putimari, Bara Atiabari, Gitaldaha, Gosanimari and Petla regions.  $P_2O_5$  content is medium (45-90 Kg/ha) in a small portion of the Block like, Okrabari and

Putimari areas. Low (<45 Kg/ha) amount of phosphorous content identified in Bhetaguri and Gitaldaha regions. Potassium is the third element of soil and it is very essential for proper growths of plants. It participates in the activation of a large number of enzymes in plants. The amount of potassium ranging between <200 Kg/ha to >350 Kg/ha in the Block. It has been noticed from the observation that there is a great variety of distribution of potassium in several places of the study area. The higher (>350 Kg/ha) amount of potassium content distributed in the central, south-eastern and north-western part. This is mainly occupied in the Putimari, Okrabari, Gosanimari areas. The lower (<200 Kg/ha) amount of potassium comprises

about half portion of the Block. Bara Soulmari, Gitaldaha, Bhetaguri regions occupied by low amount of potassium. Medium (200-350 Kg/ha) amount of potassium content identified in the Gitaldaha, Bara Atiabari, Matalhat areas. Most of the cases soil can facilitate plants adapted to that climatic condition and to complete their life cycle without the addition of macro and micro nutrients as fertilizer. But it is essential to artificially improve the soil fertility by the addition of fertilizer in the soil to increase the productivity of the land. The sufficient nutrient supply can change the soil conditions and promote to sustain yield.

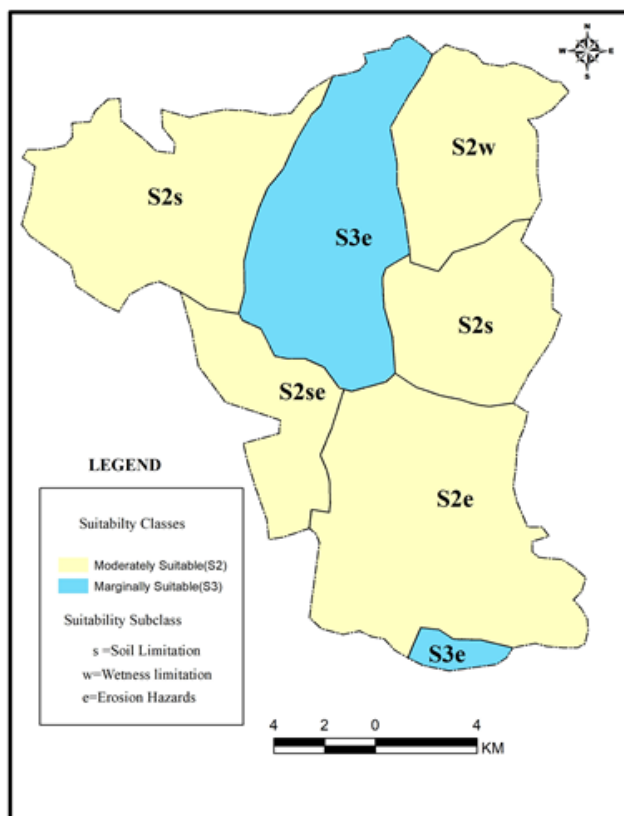


Fig. 6 Land Suitability Classification of the Study Area Based on FAO Method

Land evaluation may be defined as the process of estimating the potential of land for alternative kinds of use (Abdel Rahman, et al, 2016). It emphasised on the suitability of a particular segment of land. It is the part of the process of land use planning. FAO of United Nations has used the term 'suitability'. The classes of suitability are assessed individually for each kind of land use under consideration with respect to each land mapping unit in the survey area. In the late 1960s, the FAO realized the importance of methodological framework to aid agricultural planning. The physical characteristics of the study area like, relief, drainage, geology, vegetation cover, soil PH, NPK content, sand, silt, and clay contents manifested on

the properties of land of this region. In the study area two step approach for evaluating the land has been carried out i.e. diagnose and rate land limitations. The study area has been classified from the suitability view point shown in figure 6 into two suitability classes, namely, moderately suitable (S2) and marginally suitable (S3) and further divided into five sub-classes namely, S2s, S2se, S2w, S2e, S3e. According to land suitability order, land can be classified as 'suitable' or 'not suitable'. Here most of the land falls under suitability zone. The maximum area of the lands of the Block is S2 land, i.e. moderately suitable having few limitations.

Table 4: Area-wise Suitability Class of the Study Area

Code	Class	Area in Sq. km	Area in %
S3e	Marginally suitable	51.42	20.68
S2w	Moderately suitable	27.75	11.17
S2s	Moderately suitable	75.69	30.45
S2e	Moderately suitable	68.96	27.75
S2se	Moderately suitable	24.72	09.95

Source: Computed by the Authors

S2 land is found in the Gosanimari, Petla, Bara Soulmari, Bara Atiabari, Bhangni and Bhetaguri regions of the Block. These lands mainly are affected by soil limitation, erosion hazard, and wetness limitation. A small portion of the lands mainly in the northern and southern part of the Block is marginally suitable. Matalhat and Gitaldaha areas are characterised by S3 land. These lands are having severe limitations which in aggregate are severe for sustained application of a given use. These lands are mainly affected by

erosion hazard. Suitability sub-classes refer to the different types of limitations. In study area authors have found three kinds of limitation i.e. soil limitation (s), wetness limitation (w) and erosion hazard (e). Site-wise analysis shown in figure 6 and percentage-wise suitability sub-classes tabulated in table 4. Moderate conservation practice required for S2 lands, i.e. S2s, S2se, S2w and S2e sub-classes, whereas careful conservative practice required for marginally suitable lands (S3) i.e. S3e category in the study area (Table 5).

**Table 5:** Land Suitability Classes and Sub Classes with their Criteria

Suitability classes and sub classes	Relief	Slope	Existing land use	Degree of soil water potentiality	Recommended land use	Degree of conservation measure recommended
S2s	Gentle	1-2 <sup>0</sup>	Arable farming, Maize, Tobacco	Moderate to High	Use of arable farming with less resistant variety of crops like paddy, jute, etc.	Moderate conservation practice
S2se	Gentle	1-2 <sup>0</sup>	Arable farming, Paddy, Jute,	Moderate	Use of arable farming with resistant variety of crops like Maize, etc.	Moderate conservation practice
S3e	Gentle	1-2 <sup>0</sup>	Paddy, Jute, Maize, Tobacco	Moderate to moderately high	Intensive Cultivation with paddy	Careful conservation practice
S2w	Gentle	1-2 <sup>0</sup>	Paddy, Maize	High	Wetness tolerant Jute cultivation	Moderate conservation practice
S2e	Gentle	1-2 <sup>0</sup>	Maize, Tobacco	Moderate	Use of arable farming with less resistant variety of crops like Paddy, Jute, etc.	Moderate conservation practice

*Source:* Computed by the Authors based on Field Survey and Land Judging Form (Burnham, et al, 1974)

## 5. Summary and Conclusion:

The study area is mainly covered by alluvial soil. The soil of the Block shows a multiple varieties. Due to high rainfall, high temperature, geological structure, the nature of the parent material and varied history of landscape have given rise to a wide variety of soils. The river courses are frequently changed in this region. Environmental degradation and associated problems are the most important natural problem that determines the economic and cultural development of the area. The Block has its historical background and variety of socio-economic features. This area has a rich in commercial activity which is mainly agricultural based. The Block has been characterised by cultivation of different crops with special reference to tobacco cultivation. Agriculture is the basic livelihood of this area. But this area is facing some problems of man-land ratio and population growth. The area falls under high density of population region (1134 persons/Sq. km). The human interferences in the soil due to making modify the land and natural environment also effect on the soil. Apart from the change of soil covered by deforestation and primitive method of cultivating the exposed and sloping lands were in many cases subjected to wind and water erosion. It may be said that although there are several problems in this region is present, but the prospect of this Block does not stop. To save the agrarian economy, it is necessary to evaluate the land with the help of suitability analysis. The government should take an initiative for proper management of the agricultural fallow lands

and other wastelands. It is necessary that irrigation system should be implemented properly throughout the Block. Here also need to improve in modern equipments and technologies for agricultural practices. The government through local administrative bodies can promote education among farmers, which is mainly related to agriculture. It is the primary duty of the inhabitants of this region to be aware about the land and agriculture. It is really hard to prescribe specific strategies to develop the status of surface soil, especially when the matter is concerned to mono-cropping like paddy cultivation as spatial variations both in terms of soil characters and regional plus socio-cultural aspects are involved. The farmers should have also supplied with good varieties of seeds and financial supports from the co-operatives to develop their agricultural activities here. This kind of analysis allows to identify the main limiting factors for the agricultural growth and enables decision makers such as land users, land use planners, and agricultural support services to develop a crop management ability to overcome such constraints and for increasing the productivity. It can say that, good and encourageable government policy and good co-relation between the government and local people can solve most of the problems in this region.

### Acknowledgement:

The authors have the sincere thanks to Dr. Sudip Kumar Bhattacharya (Assistant Professor) and Jayanta Das (Research Scholar), Department of Geography and Applied

Geography, University of North Bengal to have the opportunity to work on the subject under their suggestion and without their constant living guidance, inspiration, encouragement and effort through the entire processes, the present research work would not have been completed. The author has equally thankful to agricultural officers of the Dinhata Block-I, officers of the Central Tobacco Research Institute of the Dinhata, and Land &

Land Reforms officers of the Dinhata Block-I. The authors are also thankful to the United States Geological Survey (USGS), Geological Survey of India (GSI) and the India Meteorological Department (IMD). The authors are also thankful to the editor of the journal for suggesting modifications. The authors also extend their thanks to the reviewers for the valuable comments and suggestions.

## References:

1. Abdel Rahman, M. A. E., 2014. *Assessment of land degradation and land use planning by using remote sensing and GIS techniques in Chamarajanagar District, Karnataka* (Ph.D. thesis) submitted to UAS, Bangalore University, India.
2. Abdel Rahman, M. A. E., Natarajan, A., Hegde, R., 2016. *Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India*. The Egyptian Journal of Remote Sensing and Space Sciences (19). pp. 125-141.
3. Bandyopadhyay, S., Jaiswal, R. K., Hegde, V. S., Jayaraman, V., 2009. *Assessment of land suitability potentials for agriculture using a remote sensing and GIS based approach*. Int. J. Remote Sens. 30 (4), pp. 879-895.
4. Beek, K. J., De Bie, K., Driessen, P., 1997. *Land information and land evaluation for land use planning and sustainable land management*. Land Chatham 1, pp. 27-44.
5. Bhaskar, K. S., Gaikwad, S. T., Anantha Rao, D., 1996. *Soil site suitability evaluation for wheat: A case study*. Agropedology 6 (1), pp. 89-94.
6. Biswas, T. D. and Mukherjee, S. K., 1989. *Text Book of Soil Science*. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
7. Brady, N. C., 1985: *The Nature and Properties of Soils*. Eurasia Publishing House. New Delhi.
8. Burnham, C. P. and McRae, S. G., 1974. *Land judging Area*. pp. 107-111.
9. Census of India, 2011. *Administrative Atlas, West Bengal*. Directorate of Census Operations, West Bengal. Govt. of India. New Delhi. pp. 32-93.
10. Census of India, 2011. *District Census Handbook, Koch Bihar, Village and Town Directory*. Directorate of Census Operations, West Bengal. Govt. of India. New Delhi. Series-20. Part XII-A. pp. 109-522.
11. Clark, G. R., 1957. *The Study of Soil in the Field* (4<sup>th</sup> Edition). Oxford University Press.
12. Das, J., Bhattacharya, S. K., 2015. *Evaluation of soil fertility status in Dinhata Subdivision of Koch Bihar District, West Bengal*. In Mandal, D. K. (Ed.) *Application of geospatial technology for sustainable development*. University of North Bengal. pp. 91-107.
13. Dent, D. and Young, A., 1981. *Soil Survey and Land Evaluation*. George Allen and Unwind London. Pp. 128-139.
14. *Dinhata Block I Development Office Official Website*. From the site: [http://coochbehar.nic.in/htmfiles/Dinhata1\\_Block.html](http://coochbehar.nic.in/htmfiles/Dinhata1_Block.html).
15. Doornkamp, John C. and King, Cuchlaine A. M., 1971. *Numerical analysis in Geomorphology: An introduction*. St. Martin's Press. New York. USA. First Edition. pp. 1-96.
16. FAO, 1976. *A framework for land evaluation*. FAO soil bulletin no. 32, Rome.
17. FAO, 1977: *Guidelines for Soil Profile Description* FAO, Rome, Italy.
18. FAO, 1983. *Guidelines: land evaluation for rainfed agriculture*, FAO soils bulletin no. 52, Rome.
19. FAO, 1985. *Guidelines: land evaluation for irrigated agriculture*. Soils bulletin 55. Food and Agriculture Organization of the United Nations.
20. FAO, 2007. *A framework for land evaluation*. FAO soil bulletin no. 6. Rome, Italy.
21. Govt. of West Bengal, 2013. *District statistical handbook, Koch Bihar*. Bureau of Applied Economics and statistics, Department of Statistics and Programme implementation.
22. Govt. of West Bengal, 2016. *District Profile of Cooch Behar*. Office of the additional magistrate & district land and land reformer officer, Cooch Behar.
23. Merolla, S., Armesto, G., Calvanese, G., 1994. *A GIS application for assessing agricultural land*. ITC J. 3, pp. 264-269.
24. Mustafa, A. A., Singh, M., Sahoo, R. N., Ahmed, N., Khanna, M., Sarangi, A., Mishra, A. K., 2011. *Land suitability analysis for different crops: a multi criteria decision making approach using remote sensing and GIS*. Researcher, 3(12), pp. 61-84.
25. NBSS & LUP, 2001. *Soil series of West Bengal*. NBSS publication. No. 89. NBSS & LUP (ICAR), Nagpur. pp. 38-40.
26. NBSS & LUP, 2008. *Soils of Koch Bihar district, West Bengal for optimizing Land use*. NBSS publication. No. 1019. NBSS & LUP (ICAR). Nagpur. pp. 1-70.
27. Sathish, A., Niranjana, K. V., 2010. *Land suitability studies for major crops in Pavagadataluk, Karnataka using remote sensing and GIS techniques*. J. Indian Soc. Remote Sens. 38 (1), pp. 143-151.
28. Satyavathi, P. L. A., Suryanarayan Reddy, M., 2004. *Soil site suitability for six major crops in Telangana region of Andhra Pradesh*. J. Indian Soc. Soil Sci. 52 (3), pp. 220-225.
29. Sehgal, J. L., 1991. *Soil-site suitability evaluation for cotton*. Agropedology 1, pp. 49-63.
30. Sys, I., Van Ranst, E., Debaveye, J., 1991. *Land evaluation, Part I. Principles in land evaluation and crop production calculations*, General administration for development cooperation, Brussels, p. 40.